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ABSTRACT

The mandate to teach the theory of evolution and evolution-related concepts in biology and other appropriate science classes in public schools is relatively clear in 31 states and the District of Columbia. In the most recent state legislative sessions, some legislators made attempts to use the legislative processes to restrict the teaching of evolution or mandate teaching of non-scientific explanations of the origin of species and the universe. This paper follows the efforts of science educators who challenged these legislative actions through the use of public media. (MVL)

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Legislative Challenges to the Teaching of Evolution: The Science Educators' Response

by
Michael Wavering
Don Duggan-Haas

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LEGISLATIVE CHALLENGES TO THE TEACHING OF EVOLUTION: THE SCIENCE EDUCATORS' RESPONSE

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The mandate to teach the theory of evolution and evolution-related concepts in biology and other appropriate science classes in public schools is relatively clear in thirty-one states and the District of Columbia. The remaining nineteen states receive a below average or failing grade in the teaching of evolution and evolution-related ideas (Lerner, 2000). In the most recent state legislative sessions (e. g. Arkansas, Michigan, Louisiana, and Pennsylvania), some legislators made attempts to use the legislative processes to restrict the teaching of evolution or mandate teaching of non-scientific explanations for the origin of species and the universe.

On June 20, 2001 the American Geological Institute Government Affairs Program reported on its website (http://www.agiweb.org/gag/legis107/evolution_update0601.html) that the United States Senate became involved in the evolution controversy. A Sense of the Senate amendment was passed 91-8 as an amendment to Education Bill S.1. This amendment stated:

> It is the sense of the Senate that—(1) good science education should prepare students to distinguish the data or testable theories of science from philosophical or religious claims that are made in the name of science; and (2) where biological evolution is taught, the curriculum should help students understand why this subject generates so much continuing controversy, and should prepare the students to be informed participants in public discussions regarding the subject.

The language of this resolution significantly changed in the education bill that was reported out of the House-Senate conference committee and subsequently passed by both houses.

The states' efforts and the tactics used in the United States Congress impact our lives as science educators. What are these impacts and what are some possible responses? The

ED464359

following two case studies represent the attempts by legislators in Arkansas and Michigan to restrict the teaching of evolution.

Arkansas House Bill 2548 (2001): Déjà vu All Over Again

Chronology of Events

On March 5, 2001 the legislative sponsor introduced House Bill (HB) 2548 in the Arkansas General Assembly and the bill was referred to the State Agencies and Governmental Affairs Committee. The title of HB 2548 was:

> An Act to Prohibit State Agencies and Other Public Entities from Using Tax Dollars to Purchase or Distribute Material that They Know or Should Have Known Contains, or Presents as Factual, Information which Has Been Proven False or Fraudulent; and for Other Purposes.

Referring this bill to the State Agencies and Governmental Affairs Committee instead of the Education Committee was the first of many unusual events. The chief reason for this referral was that the chair of the committee was the author of the bill. He wanted the bill reported with a due pass recommendation by the committee to the Arkansas House of Representatives.

On March 19 HB 2548 was amended to its current form and was posted on the legislative web site (www.arkleg.state.ar.us/ftproot/bills/2001/htm/HB2548.pdf). The bill required first, specified state agencies, including public schools, not to use public funds to purchase materials which contain false evidence. Second, the information is to be as accurate as possible and, third, during instruction, when any material is deemed false according to the bill, the instructor will direct students to make marginal notes that the statement is false. Finally, during instruction the teacher will direct students to make marginal notations when any statement is identified as a theory.

The bill continued by naming seven theories but stated that the concern with theory should not be limited to these particular named theories: age of the earth, origin of life, homology in vertebrate limbs as evidence for common ancestry, geologic column accurately representing different time periods on earth, fossils representing missing links between life forms, and carbon/radioisotope and potassium argon dating. The next section of the bill defined science as:

> A special way of knowing and understanding the physical world that uses the "scientific method" to conduct rigorous investigations into processes that are observable and repeatable. . . employs skeptical peer review and experiments attempting to falsify ongoing and prior scientific work to ensure the validity and integrity of results. (HB 2548, 2001, p. 2).

Finally, the bill enumerated a list of what it labeled as false or fraudulent science but did not limit the bill to these instances. The false/fraudulent science list included: Haeckel's embryos; Miller-Urey experiment; archaeopteryx as a missing link; peppered moths; fossil horses; Heidelberg, Nebraska, Piltdown, Neanderthal, and Cro-Magnon man; Homo-erectus made from a few scraps of bone found in 1891; Lucy; vestigial structures; and lobe-finned fish.

The author of the bill admitted that much of the information in the bill came from Jonathan Wells (2000), *Icons of Evolution*. On March 19 e-mails from the Evolution Education Arkansas listserve (Evoledar-l@l2.uca.edu) provided constant updates and advice from the National Center for Science Education (www.ncseweb.org). Ironically, Monday, March 19 was the first day of spring break for most colleges and universities in Arkansas. Despite this, members of the Evoledar and the Evolution Group at the University of Arkansas (U of A) alerted the U of A academic community that this bill was in committee. Members of these groups immediately wrote e-mails to the House committee members expressing their concerns.

On Tuesday the committee heard the bill. There were two speakers opposed to the bill and a number of people who spoke in favor of the bill. The executive director of the Arkansas Civil Liberties Union and a geologist in the Department of Chemistry and Physics at Arkansas State University spoke against HB 2548. The sponsors of the bill invited Kent Hovind from Florida to speak as an expert witness for the bill. Mr. Hovind is a creationist minister who has graduate degrees in Christian education from Patriot University. After Mr. Hovind's testimony the bill passed with one dissenting vote and was sent to the House. This action prompted additional e-mails to committee members explaining the numerous problems with the bill.

I received a response from one committee member to my comments about the nature of science. "To me science is fact. Theory has not been proven. Evolution is theory." In addition I wrote to the University of Arkansas' Provost alerting him to the possible effects HB 2548 could have on the university at large and the library in particular.

On Wednesday the House scheduled the bill for consideration, but the bill ran into procedural difficulties for lack of a financial impact statement. The sponsor of the bill asked that the rules be suspended and received a 47-44 vote against suspension.

The House considered the bill again on Thursday. By this time a number of the most active science teachers in the state of Arkansas were in St. Louis for the National Science Teachers Association (NSTA) Annual Convention, where, ironically, I (Wavering, 2001(a)) was presenting a paper titled, "Why is Evolution a Dirty Word?" Meanwhile, a spirited floor debate occurred in the Arkansas House. One of the legislators was quoted as saying, "This law is clearly unconstitutional. Folks, if we pass this, we will not be shooting ourselves in the foot; we'll be shooting our foot off" (Fulton, 2001, April 14, e-mail communication). When the vote was taken, 45 voted yes, 36 no, and 19 either didn't vote or voted present. In the Arkansas

Legislature 51 votes are needed for passage; consequently, the measure failed. The sponsor wasn't sure whether he would bring it up again in the legislative session with only three weeks remaining.

Even though the legislative action had ceased for a short time, e-mails to legislators continued from the opponents and proponents of HB 2548. Editorials and letters to the editor became a daily affair in the newspapers. Between March 23 and June 4 more than 40 letters and editorials appeared in the *Northwest Arkansas Times* and the statewide *Arkansas Democrat-Gazette*.

During this time I wrote e-mails to all the members of the Arkansas House who voted against, present, or didn't vote for HB 2548 thanking them for not supporting the bill and providing them with more information about the problems with the bill. Members of the Evoledar and U of A Evolution groups provided members with information on sources for the bill and information about the particular charges made by the bill with regard to false or fraudulent science. I received e-mail messages from three members of the legislature thanking me for my e-mails. Apparently, the legislators were receiving many messages criticizing them for their votes and were grateful to receive some encouragement for a vote that might be controversial with their constituents.

The science curriculum specialist at the Arkansas State Department of Education played a key informational role while HB 2548 was moving through the legislative process. During this week he asked me to contact a local legislator who wanted more information about the problems with the bill. Her e-mail thanking me for the information included the following, "Although the 'educated' community has applauded my vote, I have had some people berate me as tho(ugh) I am some type of atheist" (Borhauer, 2001, March 27, e-mail communication). Further, I wrote

the director and associate director of the Arkansas Department of Education briefing them on the faults of HB 2548.

When the Kansas problem with evolution occurred a year and half earlier, I wrote a guest editorial concerning the impact of that action on the state of Arkansas (Wavering, 1999). An editor at the *Arkansas Democrat-Gazette* was receptive to me writing another a guest editorial this time about HB 2548. It was published on Monday, April 2 (Wavering, 2001(b)) and was titled, "It's Just a Theory" (see Appendix A). The editorial stated my opposition to HB 2548 was based on its distortion of science and use of the word theory and that NSTA had a good definition of the nature of science at its website (http://www.nsta.org/handbook/natureofscience.asp).

On April 3 a motion to expunge the vote of March 23 failed, but on April 12 the Arkansas House voted to expunge the vote on which HB2548 failed to pass. This vote was 70 yes, 5 no, 4 present, and 21 not voting. On April 7, I wrote the executive director of the Arkansas Science Teachers Association (ASTA) encouraging the organization to develop a position statement that would help the organization respond to the challenges provided by HB 2548. Board members of the ASTA had written letters to the legislators and the state department of education but had not been able to respond in a timely fashion as an organization, due to the lack of policy statements. The e-mail message outlined a three-prong statement about the nature of science, the teaching of evolution, and the relationship between science and religion.

This resulted in a Position Statement on Science Education which has been added to the ASTA website (www.aristotle.net/~asta/science.htm). After the vote to expunge the March 23rd vote, the letters to the editors of the state's newspapers continued for almost two more months. Two of the last letters included an interesting exchange. A thirteen year old middle school girl

wrote to say she was choosing evolution as a scientific theory ". . . backed up by a lot of evidence. It is not just something that someone dreamed up." The reply to this young woman was that she was courageous but wrong. The House postponed reconsideration of the bill indefinitely and referred it to the Education Committee for the interim during the legislative sessions, which is where it currently remains.

Michigan House Bills 4382 & 4705 (2001): The Evolution of Anti-Evolution Legislation

Chronology of Events

On February 28, 2001 House Bill 4382 was introduced by Representatives Gosselin, Garcia, Vander Veen, Bradstreet, Vear, Kooiman, Hager, Voorhees, Kuipers and Tabor and referred to the Committee on Education (of which co-sponsor Kuipers is committee chair). The bill was entitled, "A bill to amend 1976 PA 451 entitled 'the revised school code.'" (http://www.michiganlegislature.org/txt/house.bills.intro/2001-2002/4382hhhh.htm). The bulk of the bill's text is primarily tweaked technical language in the school code. The last four paragraphs of the six-page bill address the teaching of evolution. That section of the bill is shown below in Figure 1.

Prior to this proposed legislation, the controversy had reared its head in myriad ways around the state. Katy Duggan-Haas (Don's wife) worked in science teacher professional development and knew biology teachers in the area who did not teach (or accept evolution). The former president of the school board in the district in which Don lived had written an op-ed piece on how creationism and evolution should both be taught in public schools. The Michigan Scientific Evolution Education Initiative (MSEEI) had been established to help teachers to better teach evolution and to deal with the political issues surrounding the teaching of evolution.

MSEEI is intended to provide an ongoing support system for teachers. MSEEI has an extensive and user-friendly web site: http://web.grcc.cc.mi.us/mseei/.

I became aware of the legislation on March 7, when Kalamazoo College biologist Paul Olexia forwarded me an email regarding the legislation (I was then teaching at Kalamazoo College). He received the information from a former student who now works at the National Center for Science Education. I sent an email with the key text from the bill and a query about how academics should respond to science educators and scientists I knew around the state. Simultaneously, others were sending similar emails to their colleagues and these informal networks eventually overlapped and became somewhat more formalized.

Relevant text from the Michigan HB 4382 follows:

> 10) As soon as practicable after the effective date of this subsection, the state board shall revise the recommended model core academic curriculum content standards under subsection as follows:
> In the science standards, all references to "evolution" and "how species change through time" shall be modified to indicate that this is an unproven theory by adding the phrase "all students will explain the competing theories of evolution and natural selection based on random mutation and the theory that life is the result of purposeful, intelligent design of a creator."
> In the science standards for middle and high school, all references to "evolution" and "natural selection" shall be modified to indicate that these are unproven theories by adding the phrase "describe how life may be the result of the purposeful, intelligent design of a creator."
> In the science standards for middle and high school, all references to "evolution" and "natural selection" shall be modified to indicate that these are unproven theories by adding the phrase "explain the competing theories of evolution and natural selection based on random mutation and the theory that life is the result of the purposeful, intelligent design of a creator."

I also sent a more targeted email to a collection of scientists from Kalamazoo and Michigan State (where I had done my graduate work). This second email proposed that a

collection of scientists and science educators from the two institutions co-author an op-ed piece for newspapers around the state, especially those papers in the western more conservative area of the state. The group initially included myself, two biologists from Kalamazoo College, and an astronomer, and a geologist from Michigan State. Some members of the group had been contacted by the media already in reference to the bill and had been quoted in newspaper stories or on Michigan Radio (the NPR network covering much of the state based at the University of Michigan).

The media coverage allowed interested others to contact us. This led to a larger group of co-authors from a larger group of institutions, including two Christian colleges. When the op-ed piece was sent to papers, it had authors from a large public university, a small secular liberal arts institution and two conservative Christian colleges. The fields represented by the nine authors included science education, astronomy, geology, environmental science and, of course, biology. The letter is included in Appendix B.

The authors of the piece are omitted here as one of the biologists from one of the Christian institutions was called before his institution's president had received complaints from a board member about the piece appearing in the local paper. He notes the problem was more because the president did not know the letter had been sent and was therefore blindsided by the board member rather than the content of the letter per se. While he will continue to write to representatives, he is hesitant to write about the subject for publication.

The diversity of academic affiliations for the authors was intentional. With my background in Earth science, I sometimes see the creationist attacks almost exclusively on biology as a relief but more generally I see it as another red flag signaling for more public education. While the issues surrounding creationism, intelligent design and evolution may have

their political center in high school biology, the issues are clearly relevant in the Earth sciences and astronomy as well. Also whether public or private, sectarian or secular, the overwhelming majority of scientists accept evolution as a robust scientific theory.

The letter was published in at least four papers in the state. None of them listed the full raft of nine authors and calls to some papers who had not initially published the letter led to a lesson. Two papers had not published the piece because of unclear local connections. The order of authors was initially to be alphabetical, but the first alphabetical name was a latecomer to the writing effort and he did not feel it appropriate that he be listed first. Consequently I was listed first followed by the others in alphabetical order. In future such efforts, we will list the authors from local institutions or who live in the newspaper's delivery area first. Phone calls did clarify this, but it would have been quicker to list the authors in different orders for the different papers. Not every paper was called and the piece did not run in all nine papers to which it was submitted.

The publication dates ran from a few days after its April 11 submission (it appeared on April 14 in the Holland Sentinel) to a month after submission in the Jackson Citizen Patriot on May 11. The delay here was due to unclear local connections clarified by a phone call.

From early on, Greg Forbes, the director of MSEEI, maintained regular contact with John Hansen, the minority Vice Chair of the House Education Committee. Hansen was opposed to the legislation. Several others had some contact with Hansen and with sponsors of the legislation. Hansen raised the point that the majority of introduced legislation never gets a hearing and he suspected that would be the case with this as well.

I had also been in contact with Rep. Hansen and a few members of the clergy. Hansen requested names of Christians who would be credible to the sponsors of the legislation and

opposed to that legislation should a hearing be called. I did not fit this description well, but knew some who did.

Forbes also wrote "Dorothy and Toto Visit Michigan: Anti-Evolution Education Bill (HB4382) Introduced in House of Representatives" for the Michigan Science Teachers' Association Newsletter about the bill. The article ran in the April/May newsletter and is available online at http://www.msta-mich.org/publications/newsletter/newsletter.april may01/ dorothy.html.

Throughout this time, the electronic discussions going on around the state had become more formalized through the formation of Michigan Citizens for Science (MCFS), adapting from a similarly named group that had formed in Kansas. The group established a list serve and a web site (http://mcfs.netfirms.com/) and those in the Lansing area met periodically.

On May 3, 2001, a new bill was introduced by Reps. Gosselin, Bradstreet, Vander Veen, Voorhees, Vear, Hart, DeWeese, Julian, Kooiman and Drolet and referred to the Committee on Education. The complete text of that much shorter bill, Michigan HB 4705, is listed below. At this writing, January 2002, neither bill has had a hearing and it does not appear likely that either will.

> A bill to amend 1976 PA 451, entitled "The revised school code," (MCL 380.1 to 380.1852) by adding section 1164.
> The people of the state of Michigan enact:
> SEC. 1164. The teaching in a public school science class or the methodological naturalism hypothesis as an explanation for the origin and diversity of life shall not preclude also teaching the design hypothesis as an explanation for the origin and diversity of life. A public school official shall not censor or prohibit the teaching of the design hypothesis.
> As used in this section:
> "Design hypothesis" means the theory that life and its diversity result from a combination of chance, necessity, and design.

> "Methodological naturalism hypothesis" means the theory that nature is all there is and that all phenomena, including living systems, result only from chance and necessity.

The op-ed piece led to Kalamazoo College biology professor, Jim Langeland, and my appearance on a call in radio talk show. We were guests on WKMI AM Kalamazoo's Marci & Company on May 14, 2001. We only agreed to be on the show after clarifying that we would not be debating anyone in the studio, just speaking our piece and taking calls. The calls came in at a high enough volume to add an additional half hour to our scheduled hour. Most of the callers seemed to hold a literal biblical interpretation of creation (as opposed to the intelligent design position of the legislation). Unfortunately, the engineer was ill the day of the show and it was not recorded.

As a result of my name being connected with the op-ed piece, appearing on the radio and being quoted in other press sources, I have received several emails and letters. There were fewer than ten in all, and the majority came in response to the radio appearance. These responses included claims that I was harshly anti-Christian and a claim that I was not anti-Christian enough. Most common in the responses was an invitation to come to evangelical church services. None of the correspondence indicated that my involvement led to deeper understanding of the issues.

There has been no legislative action on either Michigan bill, but they have generated media coverage around the issues of creationism, intelligent design and evolution. The fact that such legislation is written (let alone brought to a vote) is a clear signal that science education has not been as effective as it should be. It is also a clarion call for public education on these issues.

Questions for Consideration

These legislative initiatives represent both a failure of science education and an opportunity for science educators. The panelists for this paper set presented case studies of efforts by legislators in the states of Arkansas (Arkansas House Bill 2548) and Michigan (Michigan House Bills 4382 & 4705) to significantly weaken the teaching of evolution in these states.

The following questions are presented for discussion. What is the responsibility of the science educator for political action? What are effective measures in taking political action? What actions are counterproductive? What are short range and long range actions? What does the frequent recurrence of these issues tell us about the contexts from which students are coming? How should that inform our teaching of future science teachers? Who are allies in this effort? What are the costs and benefits of such actions? How can we form alliances that respond to these initiatives? Should we take a more active role in the education of the public about evolution and the nature of science? What other questions do these cases suggest?

References

American Geological Institute (2001). *www.agiweb.org/gag/legis107/evolution_update0601.html*

Arkansas Legislature (2001). HB 2548. *www.arkleg.state.ar.us/ftproot/bills/2001/htm/HB2548.pdf*

Arkansas Science Teachers Association (2001). Position statement on science education. *www.aristotle.net/~asta/science.htm*

Borhauer, S. (2001, March 27). E-mail communication.

Duggan-Haas, et. al. (2001, April 14) Evolution: No Debate Among Scientists. *Holland Sentinel*

Evolution Education Arkansas (2001). *evoledar-l@l2.uca.edu*

Forbes, G. (2001) "Dorothy and Toto Visit Michigan: Anti-Evolution Education Bill (HB4382) Introduced in House of Representatives" *Michigan Science Teachers' Association Newsletter.* 47(2), 1-2, 5.
http://www.msta-mich.org/publications/newsletter/newsletter.aprilmay01/dorothy.html

Fulton, W. (2001, April 14). E-mail communication.

Lerner, L. (2000). Evolution: How does it fare in state K-12 science standards? *Reports of the National Center for Science Education. 20*(4), 44-45.

National Center for Science Education (2001). *www.ncseweb.org*

Michigan Citizens for Science (2001). *http://mcfs.netfirms.com/*

Michigan Legislature (2001) HB 4382
http://www.michiganlegislature.org/txt/house.bills.intro/2001-2002/4382hhhh.htm

Michigan Legislature (2001) HB 4705
http://www.michiganlegislature.org/txt/house.bills.intro/2001-2002/4705hhhh.htm

Michigan Scientific Evolution Education Initiative (2001).
http://web.grcc.cc.mi.us/mseei/.

Wavering, M. (1999, August 21). Why evolution should be taught. *Arkansas Democrat-Gazette.*

Wavering, M. (2001(a), March 22-25). Why is evolution a dirty word? And how to change that! National Science Teachers Association National Convention, St. Louis, MO.

Wavering, M. (2001(b), April 2). It's just a theory. *Arkansas Democrat-Gazette.*

Wells, J. (2000). *Icons of evolution.* Washington, DC: Regnery Publications.

Appendix A

Guest Editorial to the Arkansas Democrat-Gazette, April 2, 2002

It's Just A Theory

By Michael Wavering

The debate about the bill to remove fraudulent and false information from the public schools' science curricula concerns the nature of a theory. House Bill 2548 would require that

"when any statement in instructional material is identified by the instructor to be a theory, the instructor shall instruct the class to make a marginal notation that the statement is a theory."

Later in the bill, the authors define science as "a special way of knowing and understanding the physical world that uses the scientific method to conduct rigorous investigations into processes that are observable and repeatable." They also call it "a discipline that employs skeptical peer review and experiments attempting to falsify ongoing and prior scientific work to ensure the validity and integrity of results." The bill's definition of science does not, however, acknowledge the role that theory plays in science.

Theory has many meanings. In everyday usage the word theory means a guess or speculation. We all have watched television programs in which the detective makes a statement about his theory of who committed the crime.

In science, theory works differently. A scientific theory is an explanation of a set of events or observations that is well supported by previous observations and experiments. Many theories are so well supported that scientists no longer debate them, but instead do experiments and make observations to refine the details of the theory.

The major function of science is to develop these theories, or explanations. As a result, theoretical knowledge forms the basis of science. Evolution is a theory, but so are atomic theory, plate tectonic theory, cell theory, gene theory and gravitational theory, to name just a few.

House Bill 2548 names a set of theories, which are all tied to the theory of evolution, but additionally states that the bill should "not be limited" to those theories mentioned. So in essence all of scientific theory is called into question by the bill.

While it is true that theories cannot be proven, because scientists cannot observe every instance of a phenomenon, scientific theories represent the best explanation currently available.

This points to the provisional nature of scientific knowledge, in that science undergoes revision as new observations and theories are developed. The theories mentioned above and many others have undergone the rigorous intellectual scrutiny of scientists over many years and provide the best current explanations of the natural world.

House Bill 2548 represents a misunderstanding of the nature of science. For a good statement of the nature of science, I refer readers to the National Science Teachers Association web site, where there is a position statement on the nature of science. See http://www.nsta.org/handbook/natureofscience.asp.

The Arkansas Legislature should not get into the business of defining science when there are appropriate organizations that have already done so. I sent an e-mail message to this effect to the House committee before the bill came before the full House. One of the members responded: "To me science is fact. Theory has not been proven. Evolution is theory."

However, the National Science Teachers Association, in its position statement on the nature of science, states, "A primary goal of science is the formation of theories . . ."

Science is more than facts; it is based on the best current explanations, or theories, which in turn are based on a vast body of research. Theories cannot be proven. Evolution is a theory, as are all the explanations that scientists propose. It isn't "just a theory" or "only a theory," but scientific theory.

That is why, if House Bill 2548 should pass, I fear that it would make our state look ignorant and backward in the eyes of the world.

Appendix B

Michigan Op-Ed in Response to HB 4382:

April 11 2001

To the Editor:

We are writing as individual faculty members from departments of biology, geology, astronomy, and science education from several Michigan colleges and universities. We are concerned about recently proposed legislation in the Michigan House (HB4382) to change the state's science education standards to include the teaching of "intelligent design" as an alternative to evolutionary theory, and the characterization of scientific theories as "unproven."

The language of the proposed legislation refers to evolution as an "unproved theory," but this phrase is misguided for two reasons. First, evolution is a demonstrable fact--species have changed dramatically over geologic time and continue to change today. There is simply no debate about this among scientists. Secondly, evolution also has a theoretical context but the phrase "unproved theory" suggests a misunderstanding of what constitutes a scientific theory on the part of the framers of the bill. The term "theory" has a very precise meaning in the scientific community; it refers to a possible explanation (hypothesis) of the cause of observed facts that has been subjected to numerous tests. Only after an hypothesis has been successfully tested, that is, subjected to attempts to disprove it and passed--can it be elevated to the status of theory. Scientific theories are continually tested as new data and new interpretations come to light or as advances in technology provide new ways to test them.

Thus a scientific theory has been rigorously and repeatedly tested and has proved to be true as far as our current understanding allows. Scientists avoid the word "proven" because of the nature of science itself. In a sense, no scientific theory is ever proven once and for all, because our knowledge base-the raw material for testing theories-is continually expanding. Scientific theories achieve their stature by successfully explaining natural phenomena. Countless long-cherished theories (for example, the pre-Galilean concept of an Earth-centered universe) have

been relegated to the "dustbin of science," replaced by new, improved versions. As a result, scientific understanding of how the world works is constantly changing. Change is the hallmark of scientific inquiry. Current evolutionary theory successfully explains countless observations that demonstrate how life has changed over billions of years of Earth history and is continually being modified as new observations and data arise. It clearly ranks among the most robust of all theories in science.

In contrast, the concept of Intelligent Design, the belief that "life is the result of the purposeful, intelligent design of a creator," is written in stone. There are no pesky details with which to quibble, no questions left unanswered--the presence of an "intelligent designer" explains all. There is no opportunity for this explanation to change based on new data, new technology, new interpretations. It cannot be tested; by its very nature it is not amenable to disproof, correction or improvement. The concept of the intelligent designer, then, is not scientific; it cannot be regarded as a viable hypothesis or theory, and therefore does not belong in our state's science curriculum.

We think it is important for our youth to have an appropriate understanding of the issues that fall within the realm of science and those which do not. The proposed legislation confuses science with non-science and does a grave disservice to all the citizens of Michigan.